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## (54) IMPROVEMENTS IN OR RELATING TO SELF DESTROYING EXPLOSIVE CHARGES


(71) We, DYNAMIT NOBEL AKTIENGESELLSCHAFT, a German company, of 521 Troisdorf, Near Cologne, Germany, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—


This invention relates to self-destroying explosive charges.

It is a general requirement of explosives intended for use in making seismic measurements under water that they must only remain effective in the period leading up to the time when it is expected that they will be fired. However, if for any reason the firing does not take place, they must lose their explosive properties so that they will be rendered totally harmless in case they might float to the shore.

One type of explosive which has been used for seismic measurements under water is the class of plastic explosives, the plasticising component of which ofen consists of a liquid nitric acid ester gelatinised with nitrocellulose. The explosive additionally contains inorganic or organic salt components including ammonium nitrate, potassium nitrate or sodium nitrate. These explosives only disintegrate by decomposition or dissolution extremely slowly in water, since the plasticising component of these explosives, being insoluble in water, is only leached out by water with difficulty.

If the amount of the water-insoluble, plasticising component is reduced, then explosives lose their cohesion and hence their explosive properties when immersed in water. Moreover, the sensitivity of the explosive for the initiation thereof is so greatly diminished as a result of this loss of cohesion that particularly powerful initiating charges are necessary for initiating these explosives and the problem then arises of achieving the self-destruction of the booster charge which is used to intensify ignition, because the said booster charge must also satisfy the aforesaid conditions.

The conventional booster charges usually consist of brisant and/or highly brisant solid explosives as hereinafter defined, such as tetryl, hexogen, octogen, nitropenta, and trinitrotoluene which, when mixed with binders such as wax or alkaline earth stearates in small percentages, are used in the form of compressed cylindrical bodies. These highly compressed elements are not attacked at all by water and their dangerous explosive properties are retained after immersion for many years in the sea.

According to the present invention, there is provided a liquid nitrate ester-free shaped explosive charge body suitable for use in marine seismic exploration which is prepared without addition of water and which comprises a mixture of an inorganic salt component selected from ammonium nitrate and perchlorate and the nitrates and perchlorates of alkali and alkaline earth metals and a binder which gradually releases the inorganic salt component into aqueous solution on contacting with water and which comprises a water-soluble polyalcohol and/or a polysaccharide swellable by water, which polyalcohol and/or polysaccharide component is present in an amount of from 2 to 50% by weight of the charge. The salt component is preferably present in an amount of from 70 to 95% by weight of the charge.

A composition consisting of a nitrate as aforesaid and a said polyalcohol and/or polysaccharide component is itself explosive. However, according to a preferred embodiment of the invention, the composition additionally contains a brisant and/or highly brisant explosive substance, generally in a quantity from 30 to 90% by weight of said charge.

An explosive charge according to the in-

vention is sufficiently sensitive to be fired with conventional detonator caps. However, at the same time, it also has a sufficiently large explosive effect to allow it to be used as an explosive charge itself or, especially when containing a brisant or highly brisant explosive, as a booster charge in association with an explosive charge for marine exploration, in particular a plastic charge of the aforesaid type. An advantage of the charge bodies as compared with prior known explosive mixtures of alkali metal nitrates, brisant explosives and binders is that, when they are used in water, they retain their explosive properties for only a certain time, but disintegrate under the effect of water after at least one hour has elapsed and hence completely lose their dangerous explosive properties.

The time for the disintegration can be varied by varying the extent to which the explosive mixtures are compressed into pressed elements of greater or lesser density. In general, however, the density of such pressed elements should not be allowed to rise above 1.5 g/cc.

By including highly brisant explosives in the explosive charge bodies and varying the content of highly brisant explosives, it is possible to vary the power and the sensitivity of the explosive charge bodies according to the invention within wide limits, so that such charge bodies can be used as initiating charges and also as main charges and booster charges.

By the expression "brisant explosive" is meant here an explosive whose detonation velocity lies in the range of from 5000 to 7000 m/sec., for example trinitrotoluene. "Highly brisant explosives" in the present sense are those exploses whose detonation velocity is greater than 7000 m/sec., for example hexogen, nitropenta, octogen and tetryl.

Both liquid polyalcohols, and waxy and solid polyalcohols, can be used in the explosive charge bodies of this invention. Examples of liquid polyalcohols which can be used are glycol and glycerine; polyvinyl alcohol and polyethylene glycol are examples of solid alcohols which can be used. A polyethylene glycol whose molecular weight is about 300 will have a wax-like consistency and can also be used. It is essential when using solid polyalcohols that their molecular weight remains in the limits within which the compound is still water-soluble.

Examples of polysaccharides which are swellable with water which can be used in the explosive charge bodies according to the invention are the various types of starch (e.g. potato starch and maize starch) and partial hydrolysis products of starches.

The organic salt component will preferably constitute from 20 to 80% by weight of a brisant explosive-containing explosive mixture. Preferred inorganic salts are ammonium nitrate and alkali metal nitrates, in particular the nitrates of potassium and sodium. These nitrates can be partly or even completely replaced by alkaline earth metal nitrates or perchlorates or by alkali metal perchlorates or ammonium perchlorate.

The following Examples in which all parts are expressed on a weight basis illustrate the invention:

## EXAMPLE 1

A mixture was prepared from 90 parts of ammonium nitrate and 10 parts of solid polyethylene glycol (molecular weight about 20000). The mixture when compressed to a density of 0.8 g/cc could be initiated in a steel tube with an internal diameter of 25 mm by an initiating charge of 15 g of tetryl. Its detonation velocity was 3500 m/sec.

This mixture disintegrated within one hour's continuous contact with water.

## EXAMPLE 2

A mixture was prepared from 40 parts of ammonium nitrate, 40 parts of pentaerythritol tetranitrate and 20 parts of polyethylene glycol. This mixture was compressed into pressed elements with a density of 1.1 g/cc. The pressed elements could be initiated with a No. 3 detonator and, when lying freely, detonated with a velocity of 6500 m/sec. They disintegrated completely after about 7 hours' continuous contact with water.

## EXAMPLE 3

An explosive mixture was prepared from 35 parts of ammonium nitrate, 40 parts of pentaerythritol tetranitrate and 25 parts of glycerin. This mixture could be ignited with a No. 3 detonator. A shaped element formed therefrom was completely disintegrated after 6 hours' continuous contact with water.

## EXAMPLE 4

An explosive mixture was prepared from 45 parts of ammonium nitrate, 45 parts of pentaerythritol tetranitrate and 10 parts of polyvinyl alcohol.

This mixture could be ignited with a No. 3 detonator. When a shaped element formed therefrom was stored in water, it was completely disintegrated after 24 hours.

## EXAMPLE 5

A mixture was prepared from 25 parts of potassium nitrate, 45 parts of ammonium nitrate, 10 parts of hexogen and 20 parts of polyethylene glycol (molecular weight about 300, waxy consistency). It was sufficiently plastic for it to be worked in an extruder

and could be processed on the usual machines for making cartridges of gelatinous explosives.

The mixture could be initiated with a No. 6 detonator and, when compressed to a density of 0.8 g/cc., detonated with a velocity of 3500 m/sec. The plastic composition was completely decomposed when allowed to stand for 10 hours in water.

## EXAMPLE 6

An explosive composition was prepared by mixing 31 parts of ammonium nitrate, 64 parts of trinitrotoluene and 5 parts of potato starch. The composition was worked into pressed elements with a density of 1.5 g/cc.

The pressed elements remain capable of detonating in sea water for about 1 hour, but become decomposed or dissolved after standing in water for about 24 hours.

## EXAMPLE 7

An explosive composition was prepared by mixing 66 parts of ammonium nitrate, 30 parts of nitropenta and 4 parts of potato starch. The composition was worked into pressed elements with a density of 1.5 g/cc.

The pressed elements behaved in the same way as the pressed elements obtained in Example 6.

## WHAT WE CLAIM IS:—

1. A liquid nitrate ester-free shaped explosive charge body suitable for use in marine seismic exploration which is prepared without addition of water and which comprises a mixture of an inorganic salt component selected from ammonium nitrate and perchlorate and the nitrates and perchlorates of alkali and alkaline earth metals, and a binder which gradually releases the inorganic salt component into aqueous solution on contacting with water and which comprises a water-soluble polyalcohol and/or a polysaccharide swellable by water, which polyalcohol and/or polysaccharide component is present in an amount of from 2 to 50% by weight of the charge.

2. A shaped explosive charge body as claimed in Claim 1, in which the inorganic salt component is selected from ammonium nitrate, sodium nitrate and potassium nitrate.

3. A shaped explosive charge body as claimed in Claim 1 or 2, which conains a said polyalcohol which is a liquid polyalcohol.

4. A shaped explosive charge body as claimed in Claim 3, in which the liquid polyalcohol is glycol or glycerol.

5. A shaped explosive charge body as claimed in Claim 1 or 2, which contains a said polyalcohol which is a water-soluble polyethylene glycol or polyvinyl alcohol.

6. A shaped explosive charge body as claimed in Claim 1 or 2, which contains a swellable polysaccharide which is a starch or partial hydrolysis product thereof.

7. A shaped explosive charge body as claimed in any one of the preceding claims which is a compressed shaped element.

8. A shaped explosive charge body as claimed in any one of the preceding claims, which additionally contains a brisant explosive and/or a highly brisant explosive as hereinbefore defined.

9. A shaped explosive charge body as claimed in any one of the preceding claims, in which the inorganic salt component is present in an amount of from 70 to 95% by weight of the charge.

10. A shaped explosive charge body as claimed in Claim 8, which comprises from 30 to 90% by weight of the charge of the brisant explosive and/or highly brisant explosive.

11. A shaped explosive charge body as claimed in Claim 10, in which the inorganic salt component is present in an amount of from 20 to 80% by weight of the charge.

12. A shaped explosive charge body as claimed in Claim 8, 10 or 11, which contains trinitrotoluene as a brisant explosive.

13. A shaped explosive charge body as claimed in Claim 8, 10 or 11, which contains a highly brisant explosive selected from tetryl, hexogen, nitropenta and octogen.

14. A shaped explosive charge body, substantially as described in any one of the foregoing Examples.

15. An explosive charge for use in marine seismic exploration, which contains a booster charge which is a brisant or highly brisant explosive-containing shaped explosive charge body as claimed in any one of Claims 8 and 10 to 14.

16. An explosive charge as claimed in Claim 15, which comprises a main charge which is a plastic explosive which is a liquid nitric acid ester gelatinised with nitrocellulose.

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**PATENT-ASSIGNEE:** DYNAMIT NOBEL AG[DYNN]

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**BASIC-ABSTRACT:**

Explosive mixts. based on NH4-, alkali(ne earth) nitrates and binders contg. 2-50 wt.% water-soluble polyols and/or polysaccharides (starch, sugar) are decomposed in water in 1-24 hrs. The inorg. salts are 20-80 wt.% of the mixt.; the mixt. may also contain 30-90 wt.% high explosive. It is used in pressed shapes, density is not >1.5 g./cc. Suitable polyols are glycol, glycerin, polyvinyl-alcohol and polyethyleneglycol.

**TITLE-TERMS:** EXPLOSIVE SEISMIC MEASURE CONTAIN WATER SOLUBLE EFFECT

**DERWENT-CLASS:** A97 E37 K04

**CPI-CODES:** A12-T03A; E10-E04; K04-A01; K04-A04;

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